Formative assessment with understanding by design to improve students'habits of mind

by Ria yulia Gloria

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RY Gloria[1,2*], Sudarmin[1], Wiyanto[1], and DR Indriyanti[1]

[1]Postgraduate Program at State University of Semarang, Indonesia.
[2]Science-Biology Teaching Department at Syekh Nurjati State Islamic Institute of Cirebon, Jawa Barat, Indonesia

[*]Corresponding autor's email: riyulgloria@gmail.com

Abstract. The high competition in the globalization era makes students often faced with various complicated problems. Therefore, teaching process that facilitates students to have smart thingking habits and strong understanding is needed. One way to train and develop students' habits of mind is through the implementation of formative assessments. This study aims to know the effect of formative assessment with understanding by design (UbD) in improving students' habits of mind and understanding. The method used is quantitative method with one-group pre-test post-test design. The result of the research shows that there is a significant increase both in student's habits of mind and student's understanding. The student's habits of mind increases by 43,9%, while students' understanding increases by 45%.

1. Introduction

Globalization era is an era of competition and challenge. In this era students often have to confront various problems. Therefore smart thinking character (habits of mind) and high level thinking skills are needed. Today's learning should be able to train and facilitate the formation of habits of mind and understanding. Habits of mind are a combination of various skills [1], while understanding is a group of abilities which are interconnected [2].

Generally today's learning is only prioritized to get the score of learning outcome by ignoring the understanding and character of thinking. Learning in schools is focused more on acquiring material mastery, regardless of what students get relating to their lives after mastering the material. In addition, the assessment of learning outcomes is only done at the end of learning or summative tests. Often teachers and lecturers ignore the assessments done during the learning process. Assessments made during the learning process are called formative assessments, such assessments are important in improving the habits of mind and students' understanding.

Opinions about habits of mind and the reasons for the importance of having the habits of mind among others are: habits of mind can develop personal skills and self-regulation [3]. Another opinion is, habits of mind is a combination of various skills [1]. Every individual should have habits of mind, this is because Individuals who have good habits of mind mean having character and behaving intelligently (to behave intelligently) when facing problems or facing unknown answers [4-6].

In addition to the habits of mind, understanding should also be owned by students. Some opinions on understanding reinforce the importance of these thinking skills. The results of research on the students' ability to understand conducted in one of the universities in West Java found out that it was still around low and moderate [7]. While some opinions on understanding say among others: students'

understanding can be expressed through student innovation during practice or application [8]. Understanding begins when something is self-directed, or self-understanding [9]. Understanding refers to something that can be transferred that has a big idea and has a value [10]. Understanding according to Wiggins consists of six aspects namely, explaining, interpreting, applying, empathizing, having perspective, and knowing yourself. From all these opinions we can conclude that having understanding is important.

To obtain the habits of mind and understanding learning activities that can train the formation of them are required, one of them is by giving the appropriate assessment. Today many assessments do not fit the way the brain works [11]. Formative assessment can be an alternative way to form habits of mind and understanding, this is because formative assessment has components of feed-back, peer-assessment, and self-assessment. The components of formative assessment i.e. feedback, peer assessment, and self assessment applied to formative assessment strategy if done correctly will encourage the formation of habits of mind and understanding.

The role of formative assessment in forming the habits of mind and understanding is inseparable from the character and the advantages of formative assessment. Formative assessments relate to how to conduct assessment during the learning process, which is about the students' active role and the process of student learning experiences that take place during learning [12-14]. Formative assessment consists of information compiled by teachers or lecturers, during daily meetings. The formative assessment also shows the internal processing of student information, development of students' understanding, interaction among students, and discussion as a tool for exchanging ideas[11]. In addition the formative assessment involves communication between teachers and students, or between students and students to gain meaningful learning [15].

Formative assessment can encourage the formation of habits of mind, this is supported by the presence of formative assessment components and formative assessment strategies used in the learning process. The components of formative assessment in the form of feedback, peer assessment, and self assessment applied to the formative assessment strategy if done correctly will encourage the formation of 16 habits of mind categories [1]. Formative assessment will encourage the formation of students' understanding which includes 6 aspects of understanding, that is explain, interpret, apply, empathize, have perspective, and have self knowledge [16]. Some studies have proved that formative assessments have a positive effect on thinking skills, such as, formative assessment gives students confidence and optimism, and forms habits of mind [17-20]. Formative assessment makes students more interested in Biology subjects [21]. Formative assessment components in the form of peer-assessment can be used and valid in terms of explaining differences in student final exams [22].

The problem is not all the formative assessment strategies that students receive in lectures are in line with their needs. In this research we will apply formative assessment through the stages of UbD, which aims to form the habits of mind and understanding of the students. In contrast to other studies, this research used inverse design that is understanding by design in choosing a formative assessment strategy used. UbD is a way of thinking that has a careful purpose and has understanding as its purpose [10].

2. Method

The research wa carried out through a quantitative research with quasi experiment design [23]. The improvement of students' habits of mind and understanding was measured by Pretest and posttest evaluation (Table 1).

Table 1. Research Design

Pretest	Treatment	Postest
O_1 and O_2	X_1	O_1 and O_2

Note: O_1 = Test to know students' Habits of Mind
O_2 = Test to know students' understanding
X_1 = The application of formative assessment through UbD

Participants in this study were 6th semester students in the academic year 2016-2017, which amounted to 31 people. They were students of biology education at one of Islamic universities in West Java. The subject that applied formative assessment through the Ubd stage was the course of Plant Physiology.

The instrument used to measure the students' habits of mind was a questionnaire. The habits of mind quesionaire consists of 21 questions covering 16 categories of habits of mind by Costa & Kallick. Meanwhile, to measure the students' understanding we used comprehension test consisting of 30 questions covering 6 aspects of understanding according to Wiggins& McTighe.

The formative assessment was applied for one semester consisting of 12 theoretical meetings and 5 times of practicum. Formative assessment strategies applied to theoretical learning are discussion, presentation, analysis of scientific articles, and mind mapping. While the formative assessment strategy applied in practicum learning is discussion, presentation, and practicum report.

Formative assessment consists of three components, namely feedback, peer assessment, and self assessment. Prior to applying the formative assessment with UbD, pretest was given to find out the students' habits of mind and understanding. Pos-test was given at the end of the semester after the learning was complete.

The data, both about the habits of mind and student's understanding, were analyzed using paired t test to see the difference of the values between pre-test and post test. Increased students' habits of mind are seen based on N-Gain values (Table 2).

Table 2. N-Gain Criteria

N-Gain Criteria	N-Gain
Low	0 – 0.30
Medium	0.31 – 0.69
High	0.70 – 1.00

3. Results and Discussion

3.1. Students' Habits of mind

The effect of formative assessment through the stages of UbD on habits of mind is known by performing an analysis of the values of pre-test and post-test on students' habits of mind . The results of the analysis show the value of t count is 14.704, and the value of significant is 0.000, which means there is a difference of habits of mind value before and after treatment. This means that the formative assessment through the UbD stage has an effect on the formation of habits of mind.

Table 3 shows a graph of the comparison of N-Gain categories obtained. From the table it can be seen that the increase of habits of mind is only between low and medium, there is no student who has high score on habits of mind (0%).

Table 3. N-Gain of Students' Habits of Mind

No	N-Gain Criteria	Quantity	Percentage (%)
1	Low	5	16
2	Medium	26	84
3	High	0	0

Formative assessment through the UbD stage is applied effectively to the improvement of habits of mind. This means that the formative assessment through the stages of UbD can train students to obtain categories that belong to the habits of mind. It is in line with Sriyati's [18] research results which say that formative assessment contributes to the formation of habits of mind.

3.2. Students' understanding

The effect of formative assessment with the stages of UbD on students' understanding was identified by t test analysis i.e. by paired t-test. The output results show the value of t count is13.051 with a significant value of 0.000, smaller than 0.05, so that there is a significant difference in the average

value of pretest and postest. This means that the formative assessment through the Ubd stage affects the students' understanding.

Table 4 shows a graph of comparison of N-Gain categories of acquired understanding. From the graph it can be seen that the average value of understanding is included in the moderate criteria or 77%.

Table 4. N-Gain of Students' Understanding

No	N-gain Criteria	Quantity	Percentage
1	Low	5	16
2	Medium	24	77
3	High	2	7

Formative assessment through the stages of UbD improves students' understanding at moderate rate proving that this learning has had a positive effect. Formative assessment strategies that are carried out continuously can train students to build their understanding [16].

3.3. Comparison of The Values of Habits of Mind and Understanding

The effect of formative assessment through the stages of UbD has been known to positively improve and form the students' habits of mind and understanding. What is the comparison between the increase in the values of habits of mind and understanding? It can be seen in Figure 1.

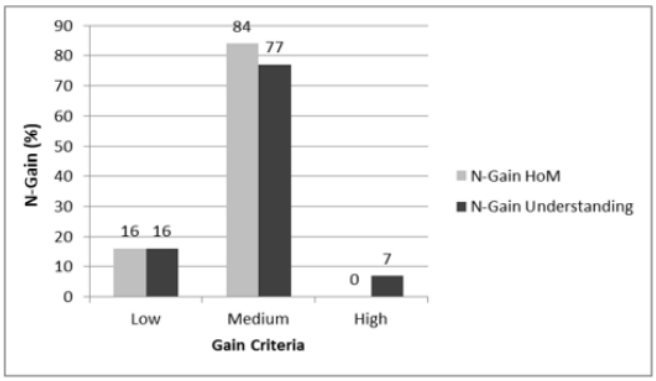

Figure 1. Comparison of Habits of Mind Increase and Understanding Increase

The graph shows ratio of increase between the habits of mind value and the students' understanding by looking at the N-Gain obtained. For improvement with low criteria, both habits of mind and students' understanding have the same N-Gain value (0.16). In contrast to the medium N-Gain criteria, the student's habits of mind increased more than the increase in students' understanding, by a margin of 7, whereas for improvement with high criterion it turns out that habits of mind and understanding are very different. Students' understanding can improve better than their habits of mind for high N-Gain criteria.

4. Conclusion

Formative assessment through the stages of UbD can improve and form the habits of mind and understanding of the students, each of which has improved with moderate criteria. Thus the formative assessment through the UbD stage can be a good alternative in order to improve the quality of students in terms of improving thinking ability.

There is a difference in the criteria of increase between the values of habits of mind and comprehension, where for high criteria, students' understanding has a higher increase compared to the

increase in habits of mind. On the contrary for the moderate criteria, habits of mind increased higher than understanding.

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